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Ecological Sites - Now and in the Future

April 18, 2017 | Jamin Johanson and Carl Bickford

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The Mission of an ES Specialist

The NRCS Mission: “Provide resources to farmers and landowners to aid them with conservation. Ensuring productive lands in harmony with a healthy environment is our priority.”



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The Mission of an ES Specialist

The NRCS Mission: “Provide resources to farmers and landowners to aid them with conservation. Ensuring productive lands in harmony with a healthy environment is our priority.”

An ES Specialist’s Mission: Produce ecological knowledge resources in support of conservation planning



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Ecology—the study of life, in context

Biology—the study of life



Environmental Context:

- Climate / Microclimate
- Geology / Geomorphology
- Hydrology
- Soils
- Land use / Disturbance



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Biology—the study of life



Environmental Context:

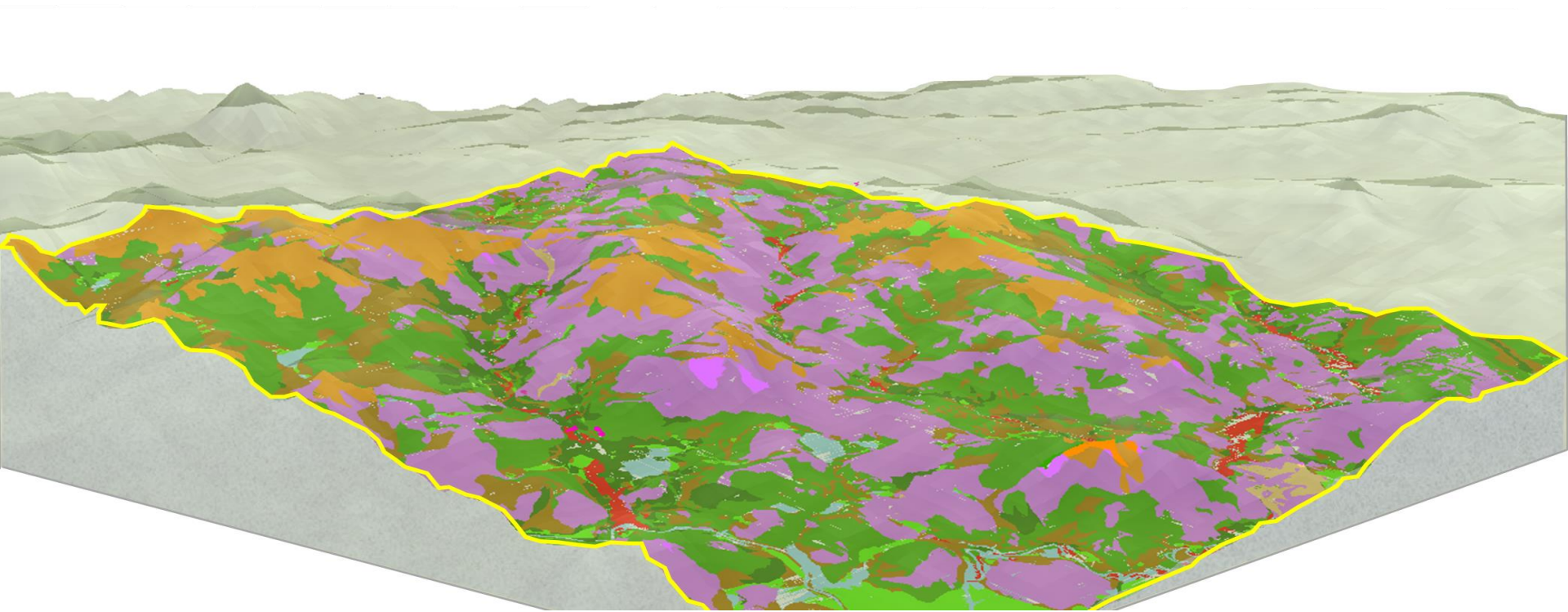
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“Life is governed by the distribution of bio-available nutrients, water, and energy through time and space.”



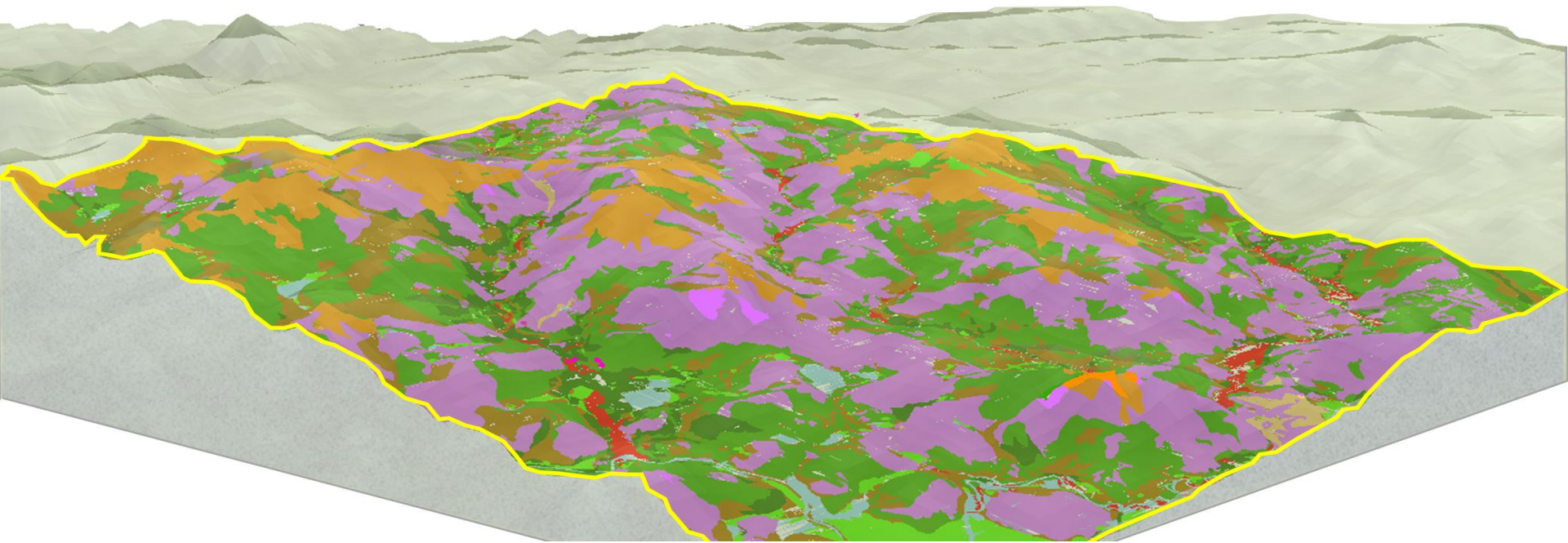
Ecological Site Definition

- 1) A **conceptual** division of the landscape into distinctive types...



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- 3) which differ from other types in their ability to produce **distinctive kinds and amounts of vegetation**...
- 4) **AND**, in their ability to **respond to disturbances** (both natural and anthropogenic).

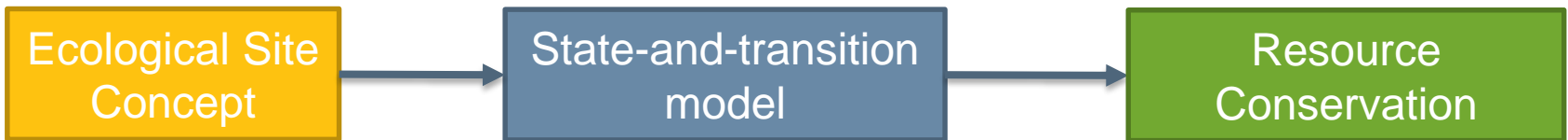


Organizing Ecological Knowledge

Spatial context
for observations

Temporal context
for observations

Context-dependent
knowledge



7. Sandy Forests

Reference State Concept

Dry soil conditions, wind, insects, and occasionally wildfire drive species composition and dynamics. Mostly white and red pine forests (some jack pine) mixed with other conifer species including red spruce, hemlock, and balsam fir. Few hardwoods, including red maple, paper birch and bigtooth aspen.

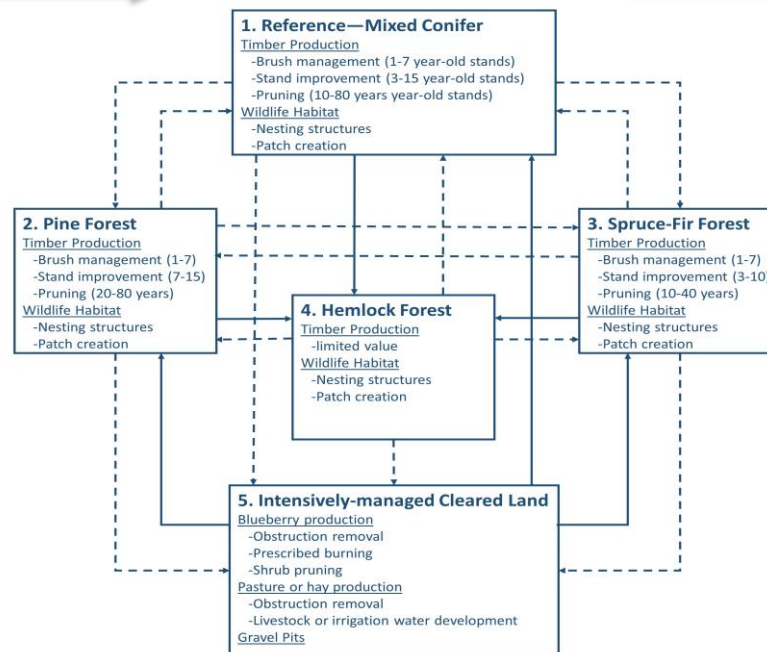
Ecological Drivers—Historic and Modern

Timber production practices. Fire—relatively more important on these sites than others (except perhaps shallow group [6]), especially with jack pine sites. Insects and disease—white pine blister rust, spruce budworm, white pine weevil all native to this site.

Within-group gradients / Context-dependencies

This group ranges from moderately well-drained to excessively well-drained, and from very steep to very gentle slopes. The effects of these and other gradients on species composition and response to disturbance are yet to be determined.

State and Transition Model ESG 7. Sandy Forests



9 Steps of Conservation Planning

Step 1	Identify concerns
Step 2	Determine objectives
Step 3	Identify resources
Step 4	Analyze data
Step 5	Formulate alternatives
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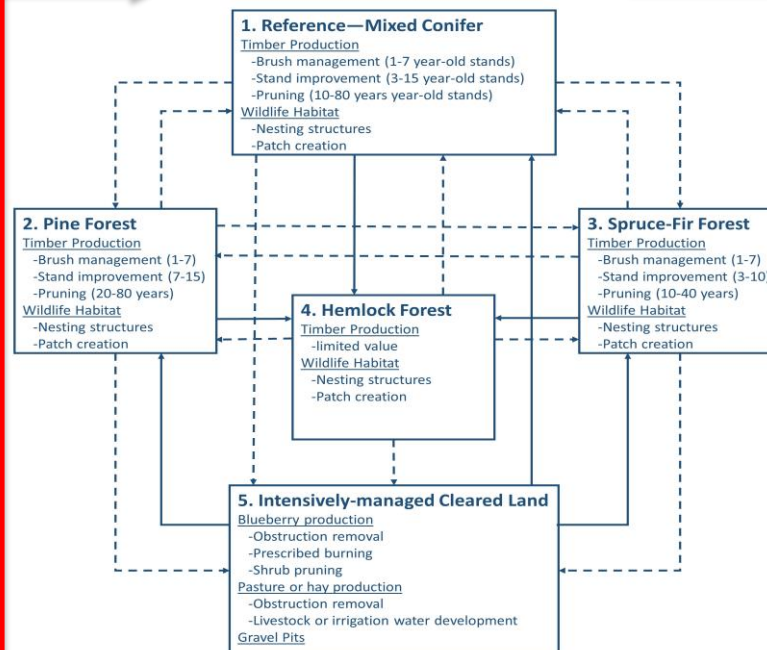
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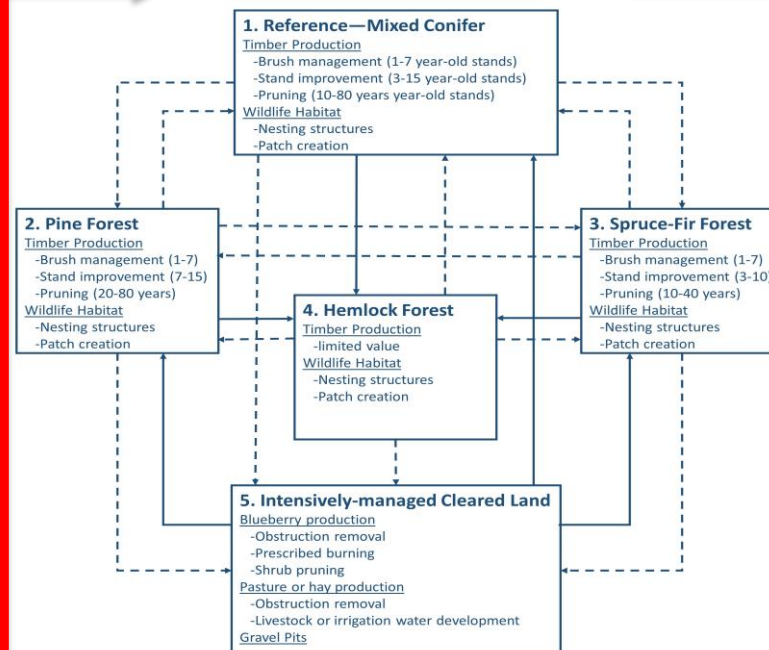
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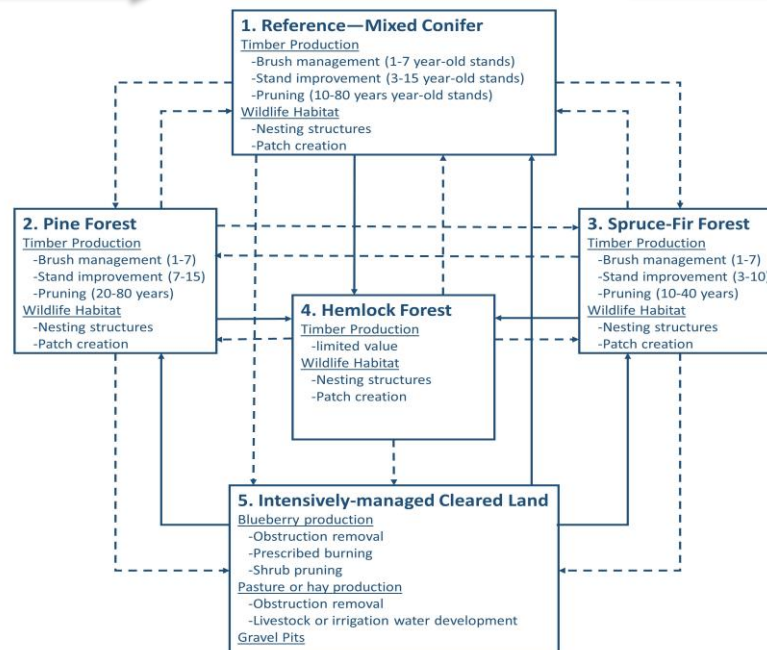
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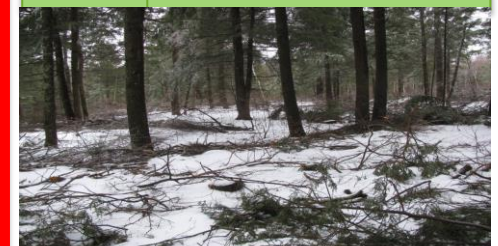
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Ecological Sites, Now and in the Future

Ecological Site Groups (ESGs of MLRA 143)

- See poster
- Johanson, J. K., Butler, N. R., & Bickford, C. I. (2016). Classifying Northern New England Landscapes for Improved Conservation. *Rangelands*, 38(6), 357-364.

Provisional Ecological Sites

- See poster
- Data collection, analysis, writing and reviews

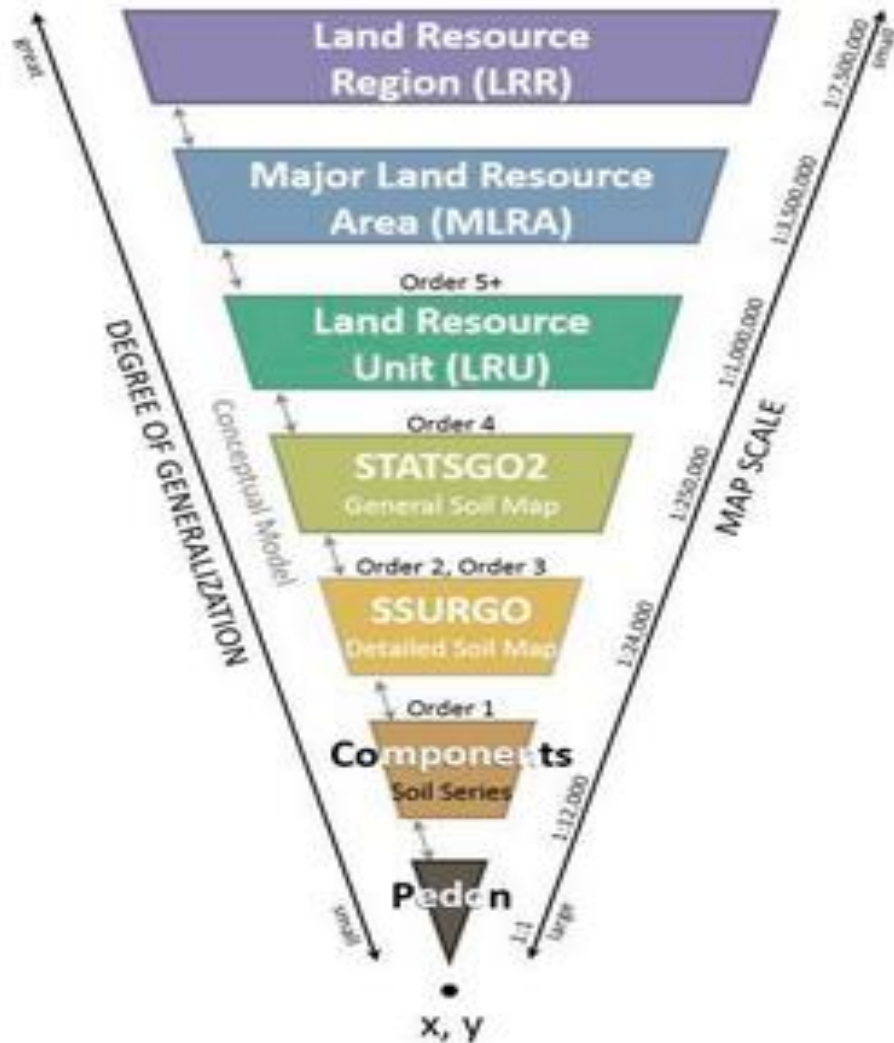
Existing very large datasets—how do we leverage these?

- NRCS Forest Management Plan data (CAP-FMP)
- Inventories from conservation partners (e.g. Natural Heritage, NatureServe)

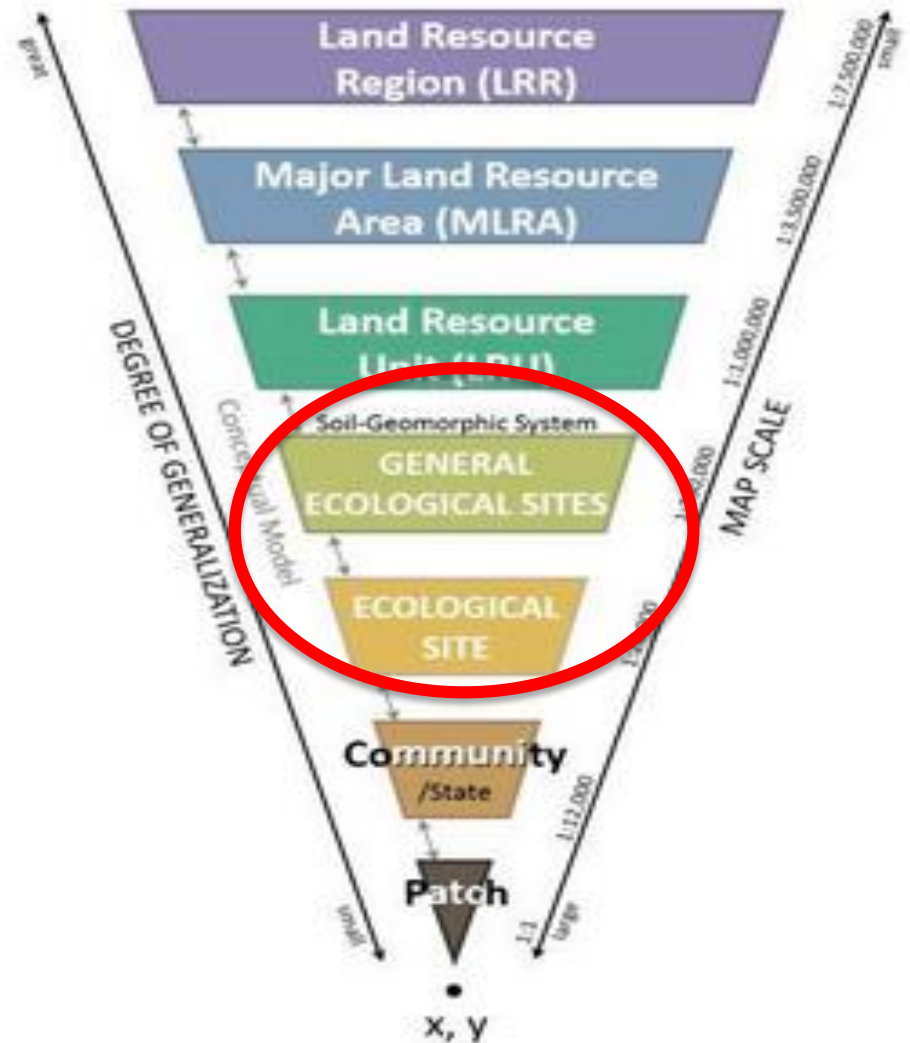


Ecological Land Resource Hierarchy

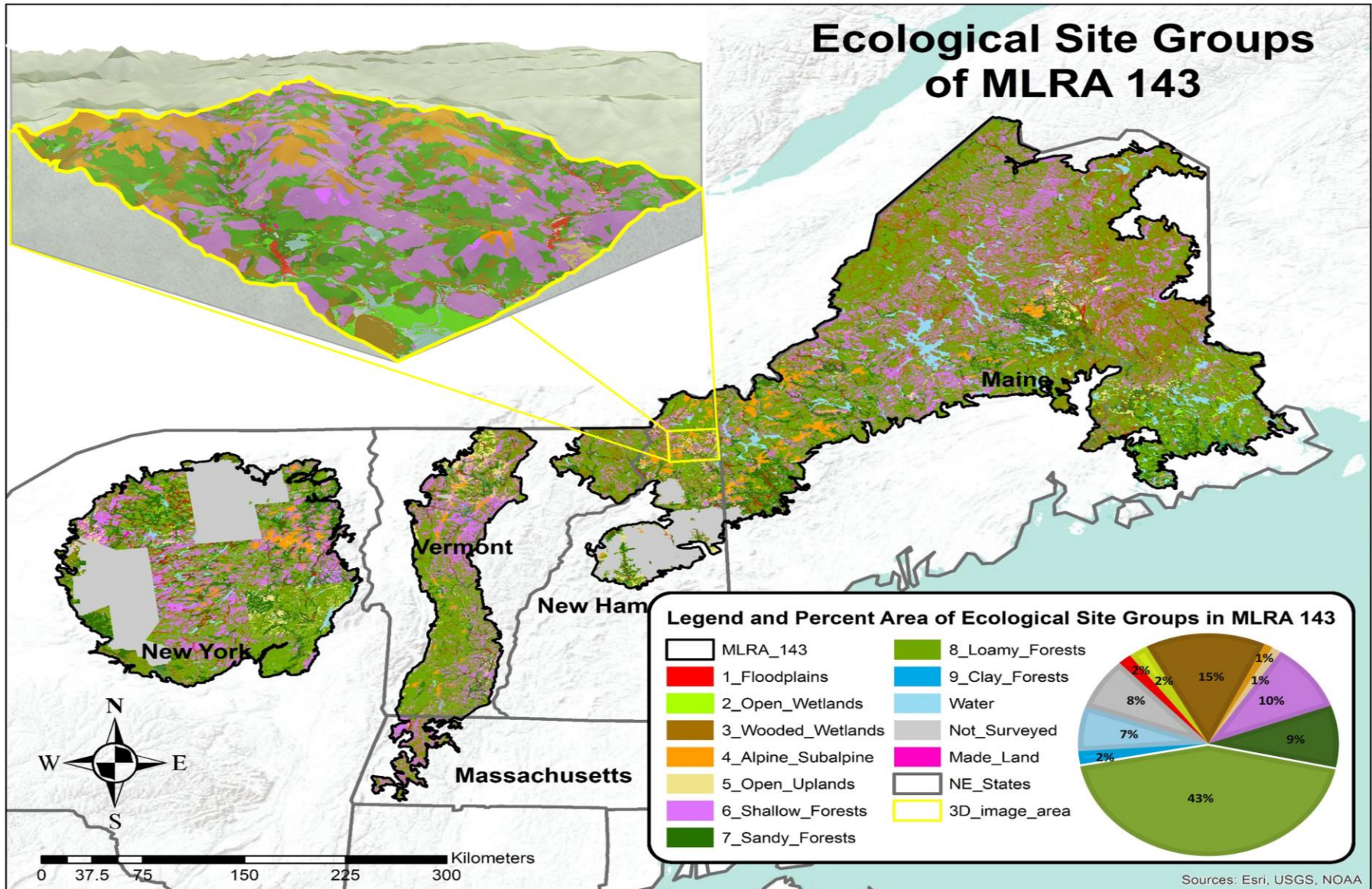
Soil-LAND RESOURCE HIERARCHY



Ecological-LAND RESOURCE HIERARCHY



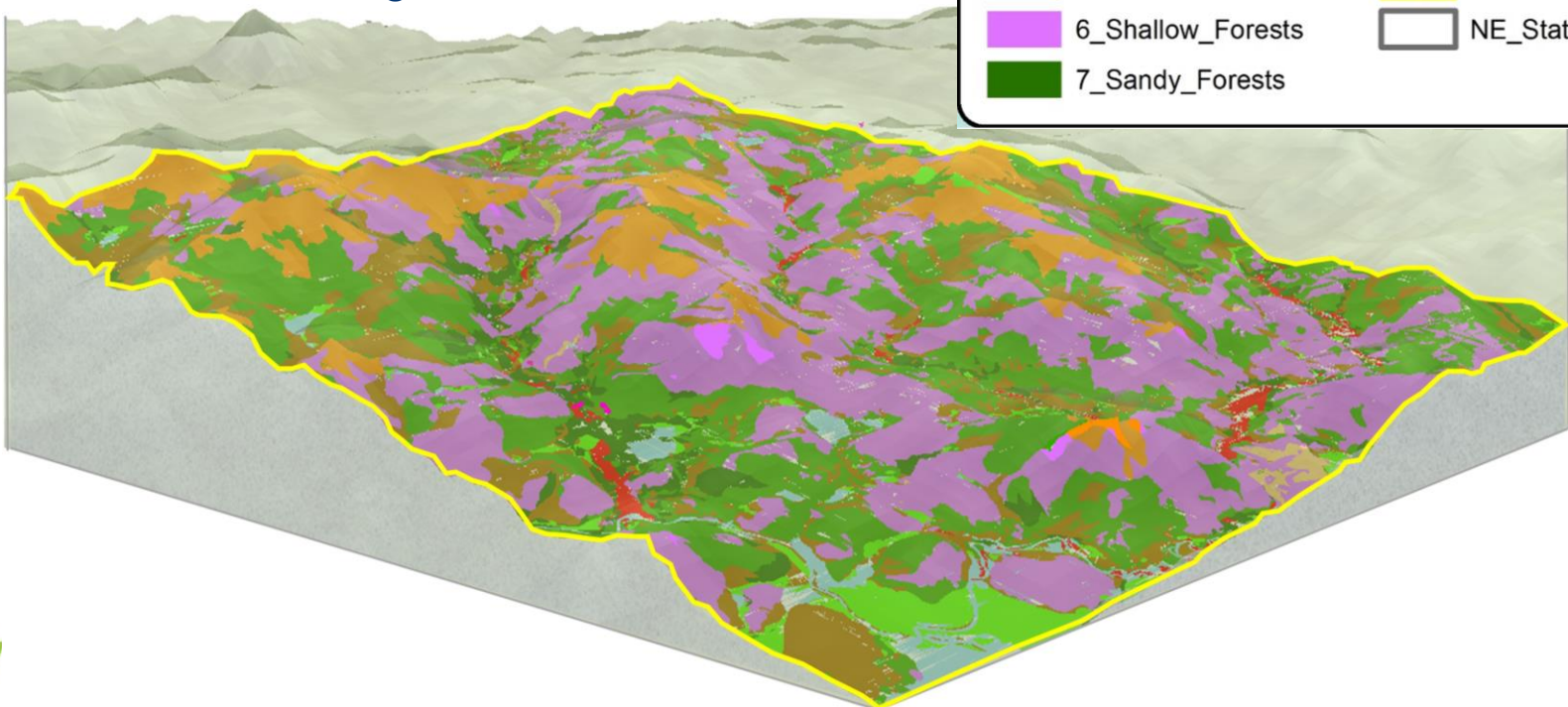
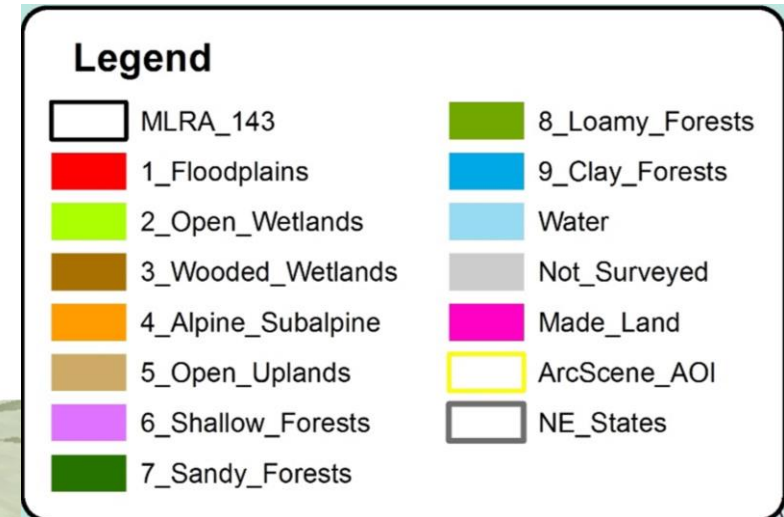
Ecological Site Groups—MLRA 143



Ecological Site Groups—MLRA 143

Guiding Principles:

- Minimum number of groups with maximum STM utility
- Similar hydro-geomorphic settings, plant functional groups, and disturbance regimes



Ecological Site Groups—MLRA 143

- Provide generalized ecological information at another scale (landscape) in the hierarchy
- Improve efficiency of ES development by grouping similar sites
- May facilitate MLRA-wide analyses of very large datasets by providing hydro-geomorphic stratification criteria
- Other benefits yet to be determined, but at little to no additional cost



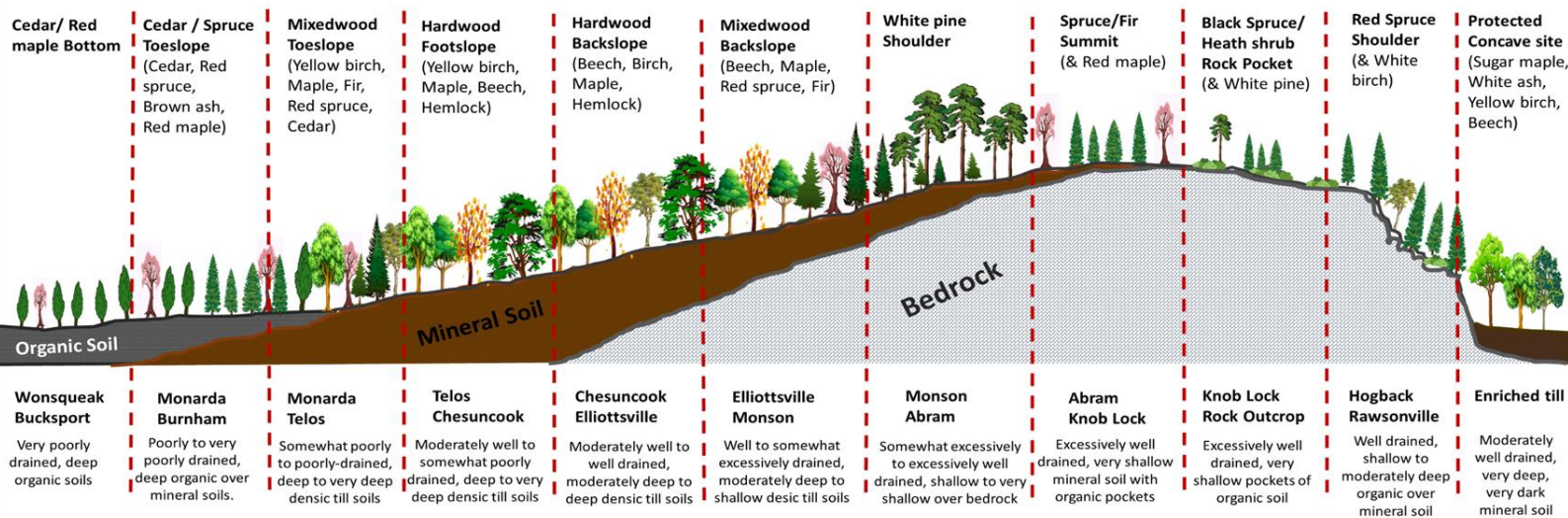
Provisional Ecological Sites

2015 field sampling:

- 202 paired soils-veg plots across till catenas in central Maine
 - ~30-60 minutes each plot (1 soil scientist, 1 ES specialist)
- Rapid full pedon description (aggregate similar horizons)
- Tenth acre veg plot
 - DBH of trees > 12.5 cm
 - Cover class of all spp, 3 height classes
- Photos, notes, slope, aspect, etc.



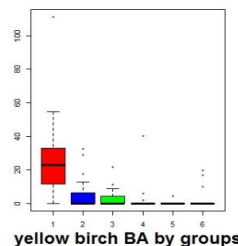
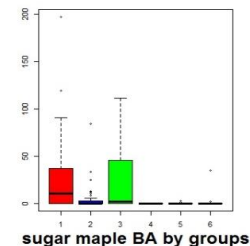
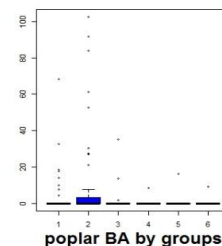
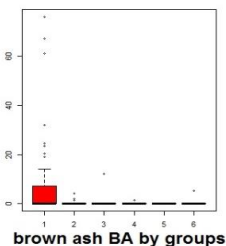
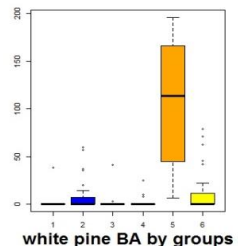
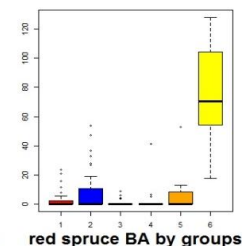
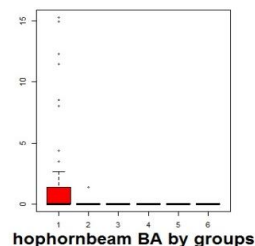
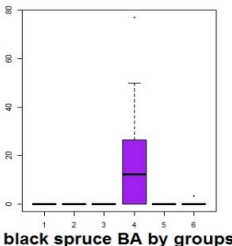
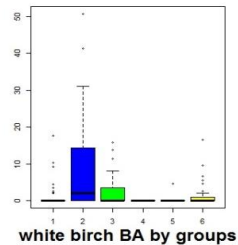
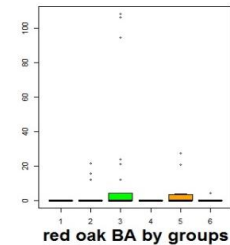
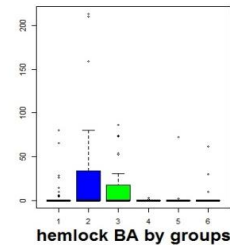
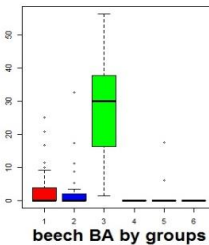
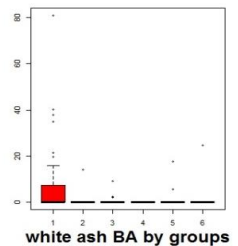
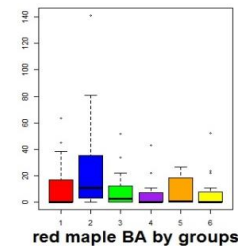
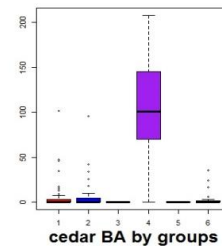
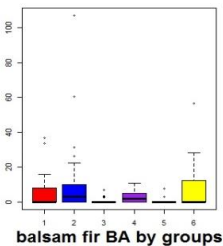
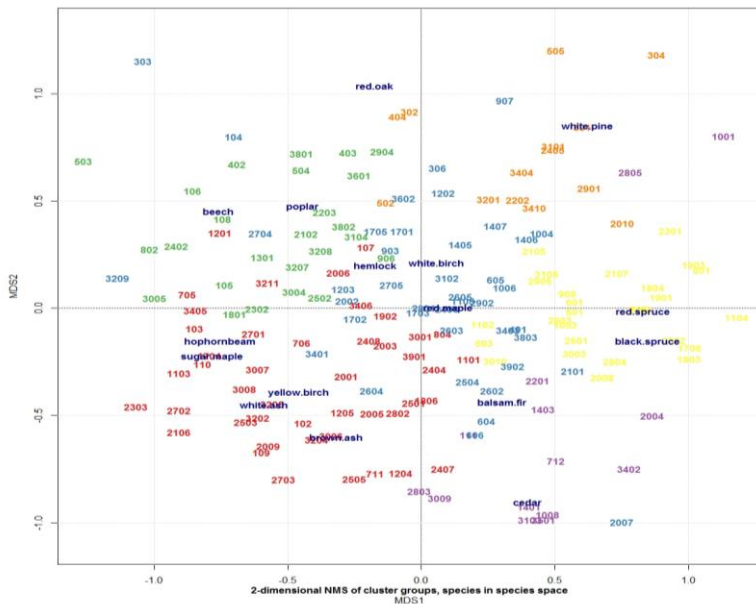
Figure 1. Simplified Chesuncook Catena with Corresponding Tree Species--DRAFT



Multivariate Statistical Patterns

Hierarchical clustering and NMS ordination help relate vegetation to soil and site properties:

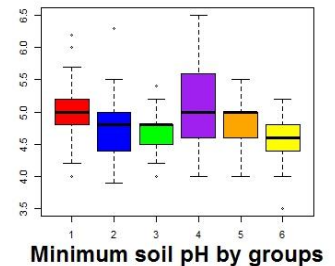
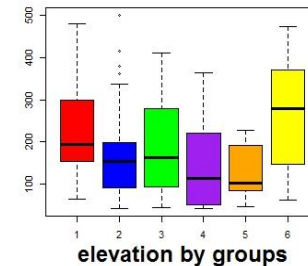
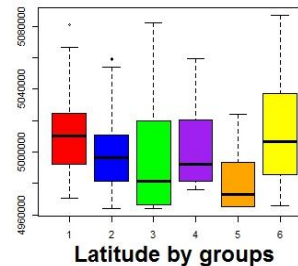
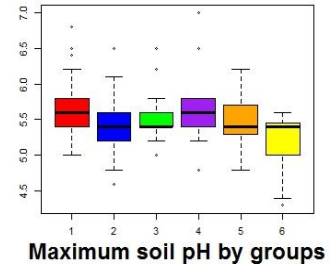
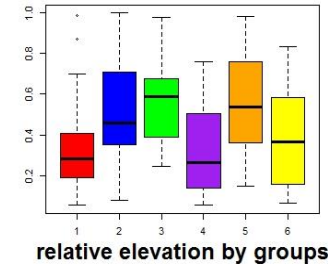
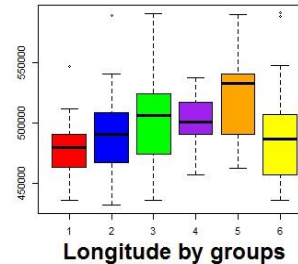
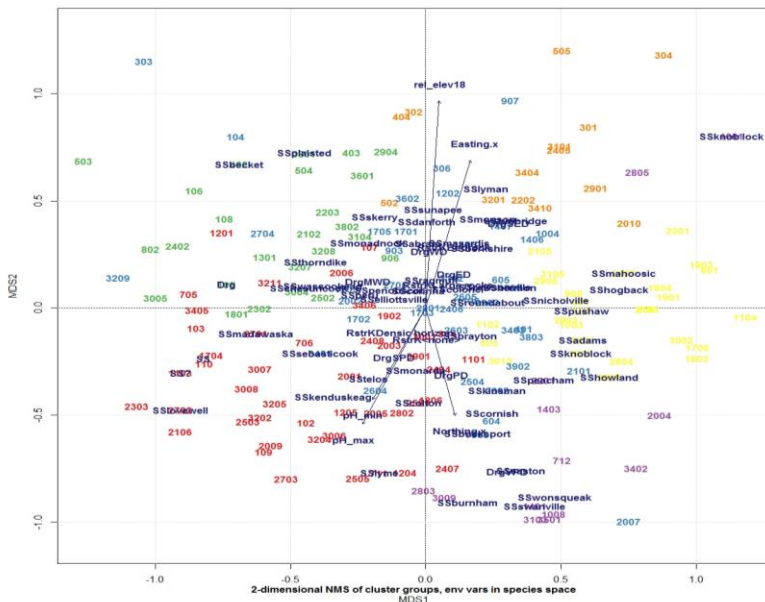
1. Red—diverse northern hardwoods
2. Blue—diverse mixedwood
3. Green—beech / sugar maple
4. Purple—cedar / black spruce
5. Orange—white pine dominated
6. Yellow—red spruce dominated



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NMS vector overlays suggest statistically significant correlations between vegetation and several soil / site variables:

1. Red—semi-rich footslopes, PD-SWPD
2. Blue—acidic slopes, MWD-SED
3. Green—acidic shoulders, WD-SED
4. Purple—cedar bottoms, VPD-PD
5. Orange—summits and shoulders, SED-ED
6. Yellow—acidic (also humic), SED-ED

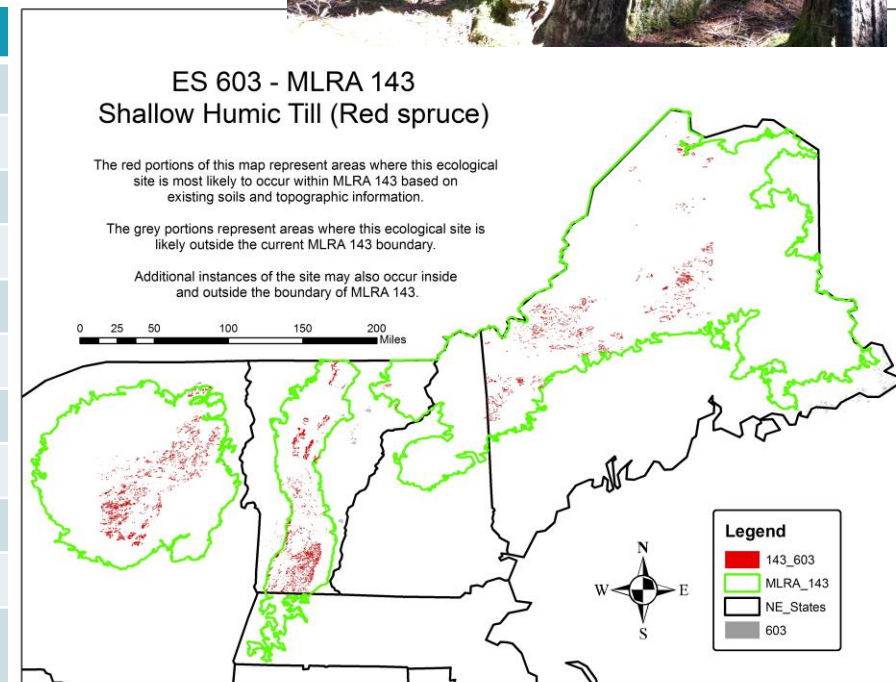
PES 603 – Shallow Humic Till (Red Spruce)



Site concept: This site occurs where soils are shallow over bedrock, usually on upper slopes and shoulder positions which shed water. The well-drained soils are characterized by very dark surface colors and a dark red subsurface horizon, indicative of high organic matter content. Slopes can be gentle to very steep. The plant community is dominated by red spruce, often with a few scattered white pine. Velvetleaf blueberry and liverworts are common in the understory. Though the soils of this site are distinctive and red spruce dominance is a repeatable pattern, it could potentially be combined with Shallow Till based on many similarities between the soils and vegetation of these two sites.



Site Properties	
Drainage class	Well
Texture class (PSC)	Coarse-loamy, loamy
Depth	10-45 inches to bedrock
Slope	Mostly 3-60%, up to 80%
Elevation	800-4400 feet
Water Table Depth	None
Ponding	None
Parent Material	Till with high organic carbon
Landform	Hills, mountains, ridges, till plains
Reference Vegetation	R spruce, liverworts, velvetleaf blueberry
Soil Components (by series)	Abram, Hogback, Rawsonville, Killington, Ricker

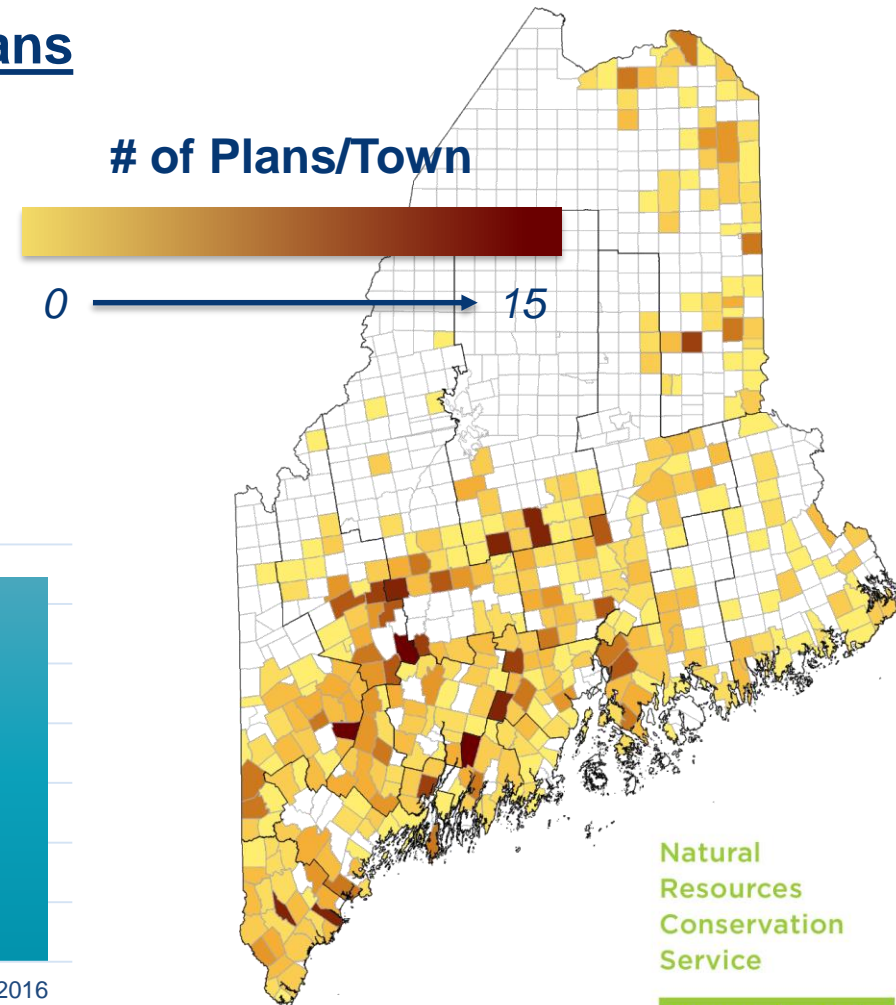
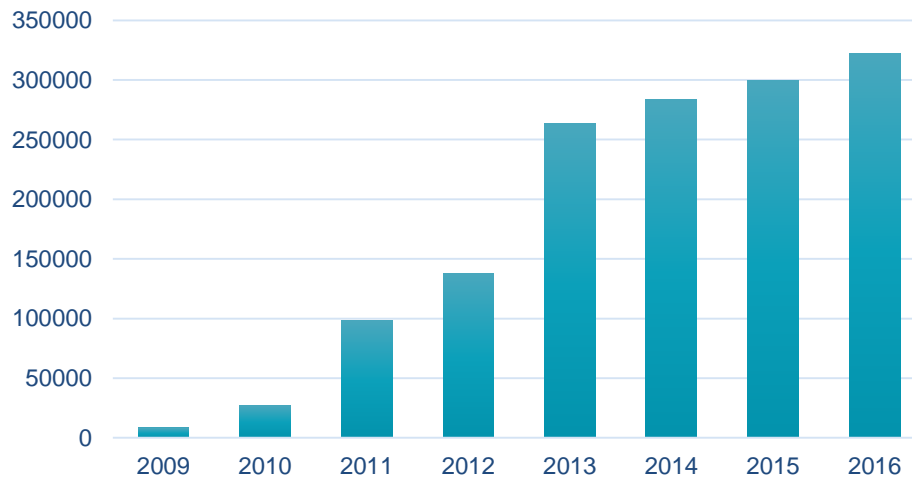


Very Large Existing Datasets

NRCS CAP-Forest Management Plans

- 2009-2016, Maine only
- 1,395 plans in toolkit
- ~335,000 acres contracted
- 1 cruise plot for every 3 acres planned
- ~111,000 cruise inventory plots

Cumulative Acres (Maine)



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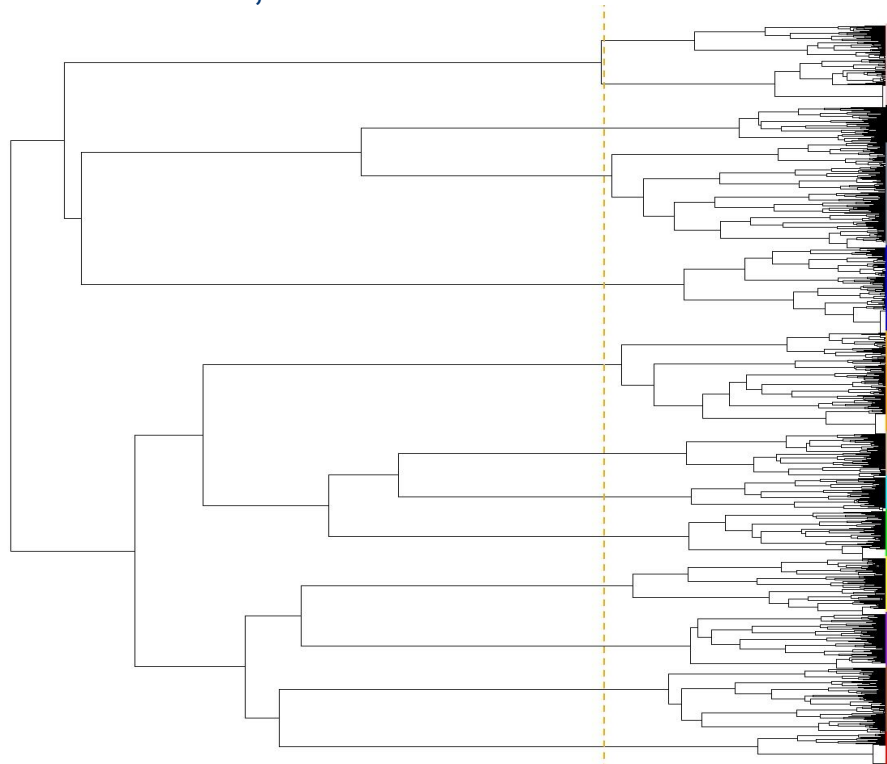
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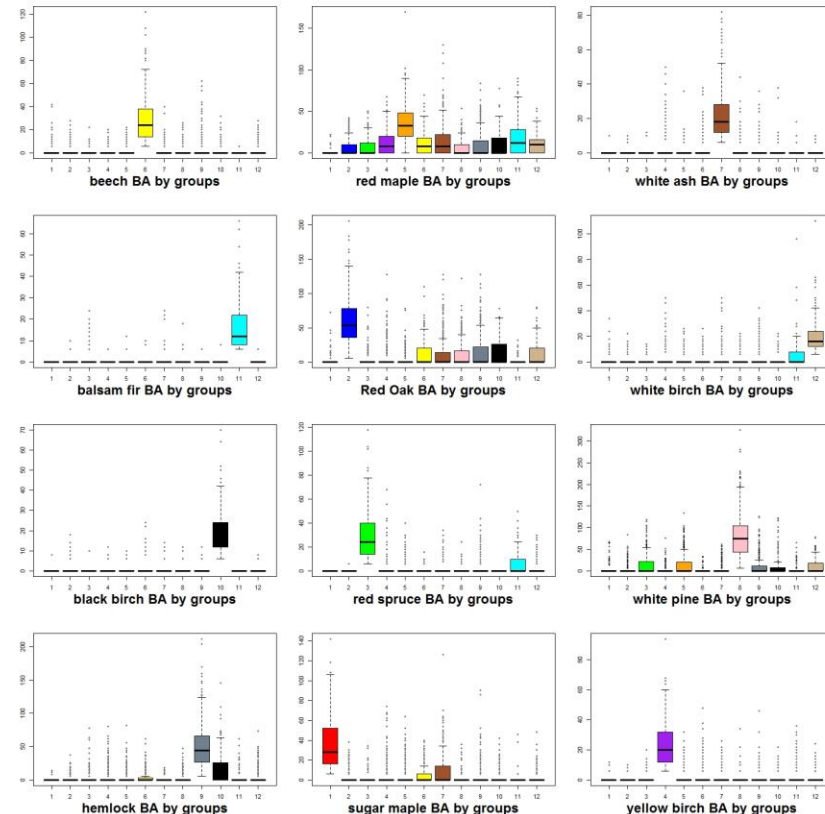
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Society for the Protection of New Hampshire Forests

- 12, 075 georeferenced cruise plots
- ~74,000 trees

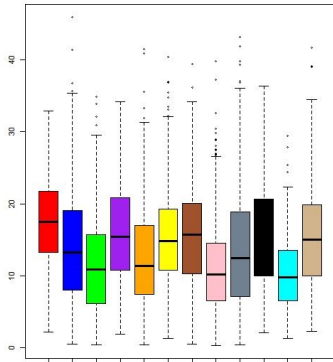


Agglomerative Cluster Dendrogram, 12 groups
(spp BA, Wards method)

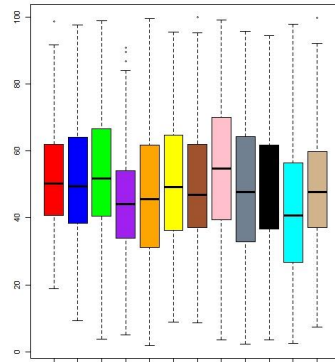


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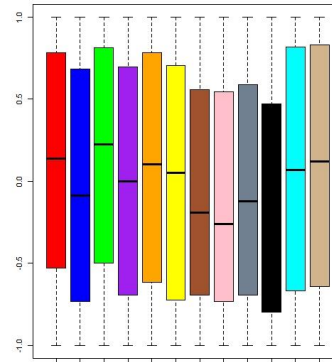
Society for the Protection of New Hampshire Forests



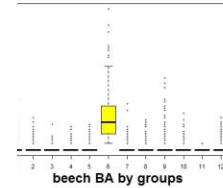
slope by groups



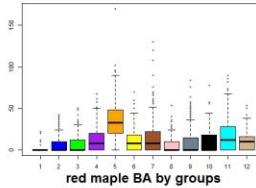
relative elevation by groups



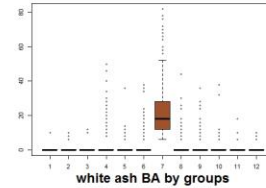
Northness by groups



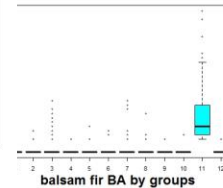
beech BA by groups



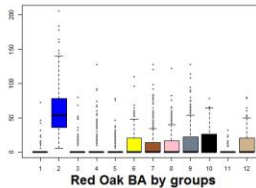
red maple BA by groups



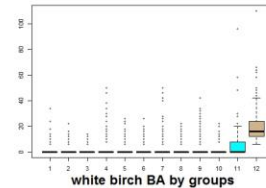
white ash BA by groups



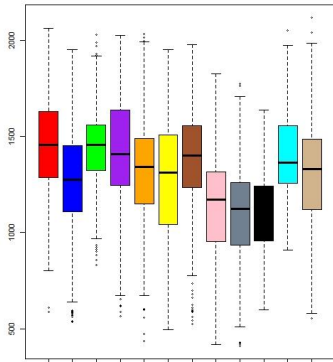
balsam fir BA by groups



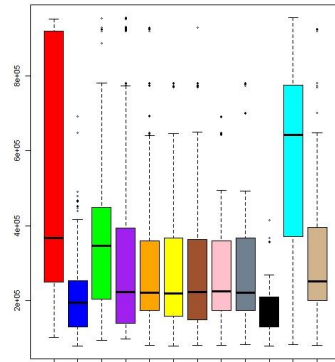
Red Oak BA by groups



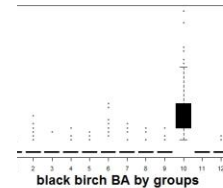
white birch BA by groups



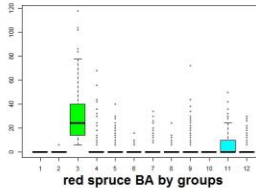
elevation by groups



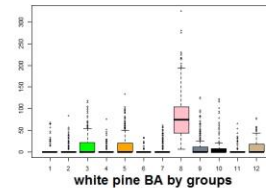
latitude by groups



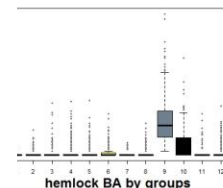
black birch BA by groups



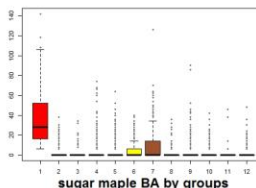
red spruce BA by groups



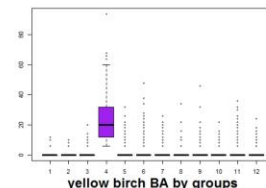
white pine BA by groups



hemlock BA by groups



sugar maple BA by groups



yellow birch BA by groups

Take Home Messages



Ecological Sites are an organizational framework of knowledge

Ecological knowledge informs conservation planning, and conservation informs ESDs

There are a lot of tools at our disposal, if we can figure out how to use them to organize our ecological knowledge

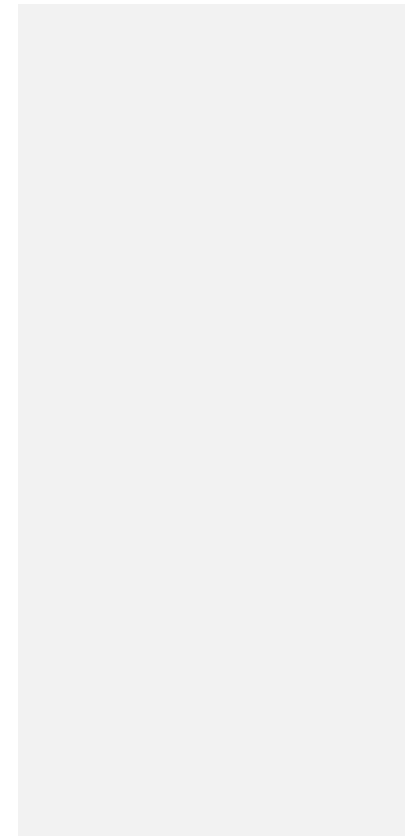




United States Department of Agriculture



Thank you



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Natural
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Provisional ES – 5 years	Approved ES – 10 years	Certified ES – 2-5 years
Region-wide projects	Site-by-site projects	Region-wide projects
Develop initial ES concepts and keys	Test and refine ES concepts and keys— Approve ESDs for general use	Make interpretations of ES concepts
Correlate every soil component to provisional ES	Adjust correlations of soil components to ESs	“Finalize” correlations
Tier I inventory	Tier II inventory	Tier III inventory
Many rapid, region-wide observations	Site-by-site data collection; Test ES concepts (i.e. hypotheses)	ES characterization at representative locations
Identify repeatable patterns in soil-veg relationships	Refine state-and-transition models; link practices to ecological dynamics/processes	Link interpretations to STMs

